Type X Pottery, Morobe Province, Papua New Guinea: Petrography and Possible Micronesian Relationships

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THE STUDY OF PREHISTORIC INTERACTION BETWEEN ISLANDS AND ARCHIPELAGOES of the Pacific has been largely concerned with processes of colonization and the development of exchange networks, both of which involved a complex flow of people, goods, knowledge, languages and genes. As Gosden and Pavlides (1994:163) point out, however, this does not mean that "Pacific societies ... were in contact over vast distances all the time," and there must have been occasions when interaction was not planned, predictable, or sustained, nor did it involve the large-scale relocation of people. Such contacts no doubt contributed to the complex archaeological and ethnographic picture in many areas, but some might have left little or no expression in the archaeological record (cf. Rainbird 2004:246; Spriggs 1997:190). We discuss here a possible example of this on Huon Peninsula on the north coast of New Guinea, where aspects of a prehistoric pottery known as Type X suggest contact between the peninsula and the Palau Islands of western Micronesia about 1000 years ago. Throughout the article, we use the term "Micronesia" solely in a geographical sense, without cultural implications (cf. Rainbird 2004).

Prehistoric links involving both colonization and the transfer of technologies between the island groups of Melanesia–West Polynesia and various parts of central and eastern Micronesia seem well established through the evidence of linguistics (e.g., Bayard 1976; Blust 1986; Pawley 1967; Shutler and Marck 1975:101), archaeology (e.g., Athens 1990a:29, 1990b:173, 1995:268; Ayres 1990:191, 203; Intoh 1996, 1997, 1999), biological anthropology (e.g., Swindler and Weisler 2000; Weisler and Swindler 2002), and cultural practices such as kava drinking (Crowley 1994). In contrast, Yap, Palau, and the Marianas of western Micronesia were settled from the west, after which they maintained links with eastern Indonesia and the Philippines as well as with communities to their east (Intoh 1997;

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Rainbird 2004:81–82, 92–93, 147; Wickler 2004). Some genetic data and rock art indicate possible relationships between Palau and the New Guinea region to the south (Lum and Cann 2000; Rainbird 2004:146), but by and large the New Guinea area has played only a minor role in discussions about prehistoric interregional contacts with various parts of Micronesia. To a large degree, this reflects the paucity of archaeological data in key areas, but the evidence from Type X and other sources summarized below suggests a complex history of interaction.

The possibility of a link between Type X and Micronesian pottery was first raised by Lilley (1988a:94), who observed a superficial similarity between Type X and Yap Laminated ware in Micronesia (Gifford and Gifford 1959:180–182). This comparison is no longer tenable on several grounds. We report here petrographic analyses of Type X that confirm the use of grog temper (crushed sherds or fired clay), a technological trait that does not occur in modern pottery of the New Guinea region (May and Tuckson 1982; Rye 1976:116) but is known in recent and prehistoric pottery of Palau, Yap, and Pohnpei (Athens 1990a; Ayres 1990; Dickinson and Shutler 2000; Intoh and Dickinson 2002; Fitzpatrick et al. 2003; Osborne 1966). Comparisons of rim forms link Type X with prehistoric Palauan pottery rather than with that of Yap or Pohnpei.

TYPE X

Type X is one of five pottery styles on coastal Huon Peninsula and the Siassi Islands, Morobe Province, Papua New Guinea (Fig. 1) that form a discontinuous sequence from Lapita to the modern industries of Sio-Gitua-Sialum and Madang (Lilley 1988a, 1988b, 1991, 2002, 2004). Lilley (1988a) initially defined Type X

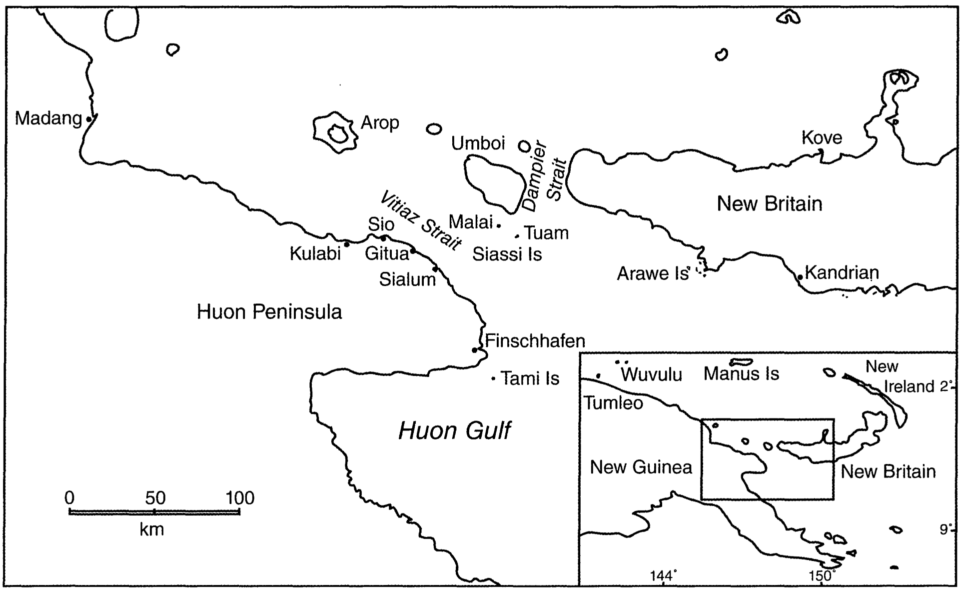

Fig. 1. Map of Huon Peninsula and New Britain, Papua New Guinea, showing localities mentioned in the text.

from sherds excavated at Sio and on Tuam and Malai Islands in the Siassi group, but it is now known from surface collections and excavations at 32 open sites and rock shelters on coastal Huon Peninsula and the nearby islands, including New Britain (Table 1). Although burials of unknown age also occur in some

TABLE 1. DISTRIBUTION OF TYPE X SITES ON HUON PENINSULA, THE SIASSI ISLANDS, AND NEW BRITAIN, PAPUA NEW GUINEA

SITE	LOCATION	TYPE	EXC./SURF.	TYPE X	OTHER	TOTAL
Huon Pen. (22)						
Finschhafen						
No code	Tami Islands	Open	Surf.	5	117	122
No code	Jabim Mission	Open	Surf.	3?	n/a	n/a
KAM	Timbulim	Open	Surf.	43	13	56
No code	Peninsula	Open	Surf.	8	1	9
Wandokai/Kanomi						
KIC	Wandokai	Shelter	Exc.	15	1	16
KID	Wandokai	Shelter	Exc.	n/a	n/a	n/a
Paradise Springs	Kanomi	Open	Exc.	n/a	—	n/a
Sialum						
KCJ	Sialum	Open	Surf.	6	4	10
KCM	Sia Island	Open	Surf.	3	25	28
KCN	Sialum	Open	Surf.	24	—	24
KCP	Sialum	Open	Surf.	1	—	1
KCR	Kwangum River	Open	Surf.	22	10	32
KCV	Sialum	Shelter	Surf.	1	—	1
KCX	Sialum	Shelter	Surf.	3	—	3
KDH	Sialum	Shelter	Surf.	3	—	3
KDJ	Sialum	Shelter	Surf.	1	1	2
KDS	Sialum	Shelter	Surf.	1	—	1
KDU	Sialum	Open	Surf.	3	—	12
KDV	Sialum	Shelter	Surf.	1	—	1
Gitua						
KBW	Gitua	Open	Surf.	3	37	40
KBZ	Gitua	Open	Surf.	21	108	129
Sio						
KBP	Sigawa Island	Open	Exc.	7	>1000	>1000
KBQ	Teliata Point	Open	Exc.	261	~8239	~8500
Vitiaz Strait (3)						
Arop Island						
JCB	NW coast	Open	Surf.	1	66	67
Siassi Islands						
KLJ	Malai Island	Open	Exc.	754	10,853	11,607
KLK	Tuam Island	Open	Exc.	285	854	1139
New Britain (6)						
Kove Islands						
FCL	Poi Island	Open	Exc.	n/a	—	n/a
FPR	Poi Island	Open	Exc.	n/a	—	n/a
Arawe Islands						
FNY	Pililo Island	Open	Exc.	76	—	2420
FOH	Adwe Island	Open	Exc.	>150	~13,000	>13,150
FOJ	Kumbun Island	Open	Exc.	1+	>7000	>7000
Kandrian						
FLE	Awakuo	Shelter	Exc.	4	—	4

rock shelters with Type X on Huon Peninsula, the presence of this pottery in midden contexts at open sites suggests that it served a domestic purpose and was not solely or primarily a funerary ware. Furthermore, its distribution across Vitiaz Strait may signal the start of connections between New Guinea and New Britain that later developed into the extensive trading network observed in historical times (Lilley 1988b). There is no precursor to Type X on Huon Peninsula.

Table 1 lists the frequencies of Type X sherds where known (n/a indicates lack of data), together with a summary of other pottery present at each site listed in the "Other" column. At more than half of the localities, Type X is represented by very small samples (<10 sherds), though the frequencies listed do not necessarily indicate the quantity present at each site. The small numbers for the Sialum area represent selective surface collections, whereas at FLE near Kandrian the four Type X sherds were the only pottery recovered from the test pit. In excavations at KLJ, KLK, and KBQ, Type X represented between 2 and 25 percent of all sherds recovered (Lilley 1986: Figs. 8.4, 8.9, 8.28), and in most excavation units it was a minor component of the pottery present. At FOH in the Arawes, Type X sherds were more common on the ground surface than the excavated sample would indicate, and the listed frequency is an estimate for both surface and excavated sherds. While there are clearly problems with estimating the absolute and relative frequencies of Type X at many sites, the overall impression is that it is not common at most localities.

Lilley (1988a) originally proposed that Type X began at c. 1600–1500 cal. B.P. and coexisted with Ancestral Sio and Ancestral Madang pottery for several centuries, with Type X ending around 850–500 cal. B.P. (Lilley 1988a, 1988b, 2004: 90–91). Reconsideration of the dating evidence now places Type X between about 1000 and 500 cal. B.P. (Lilley and Specht in review).

Type X vessels are typically rounded-bottom pots with two forms of rims (Class 1 and Class 2) and occasionally carinated shoulders (Figs. 2, 4; Lilley 1988a). The exterior surfaces are often shiny with a slightly greasy feeling and range in color from red to reddish-brown or yellowish-red (Munsell 2.5YR 4/4, 4/6, 5/6; 5YR 4/4, 4/6, 5/6). This color is probably the result of the application of a slip. Some exteriors have been burnished all over or in irregular lines. The vessels were roughly finished, leaving signs of construction by an additive process, and many sherds have a tendency to fracture into platelets or irregular lumps. The Class 1 rims have internal and external flanges added to form a T shape; some of these sagged before firing as they were too heavy to be supported by the vessel body (Lilley 1988a: Fig. 2). Class 2 rims have nearly parallel sides without flanges. Decoration consists of incised lines in diagonal or criss-cross patterns, or groups of shell-edge impressions (Figs. 2, 4; Lilley 1988a: Fig. 3). Lip modifications include sharp notches, rounded indentations, and shell-edge impressions.

Drawing on petrographic work by Watchman (1986), Lilley described Type X as lacking obvious nonplastic inclusions, with many having a "laminated" appearance and a tendency to break into thin, flat platelets. Later appraisal of sherds recovered on Huon Peninsula by Specht in 1969 and by Specht and J. Kamminga in 1972, however, showed that some share the rim forms and general appearance of Type X but contain obvious mineral and other inclusions. Type X thus appeared to be a more diverse group than Lilley's original definition allowed.

PREVIOUS WORK ON THE COMPOSITION OF TYPE X

Watchman (1986; Lilley 1988a:94) examined 17 Type X sherds within a larger sample of 134 sherds from sites KLJ, KLK, and KBQ and placed 14 Type X sherds in one paste group and the other three in a closely related one. He noted (1986:516) the presence in one Type X sherd of rounded clay clasts which, he suggested, might be derived from "broken fragments of other pots." Six other sherds assigned to Ancestral Sio and Madang pottery also contained what appeared to be fragments of old sherds (Watchman 1986:516–518, 526, 531–532). The Ancestral Sio and Madang sherds could be assigned with some confidence to clay sources similar or identical to those used by modern potters of the two areas. Elemental analysis by optical emission spectroscopy of three Type X sherds from Sio, Tuam, and the KIC shelter near Wandokai, as well as a clay sample from Tuam, did not rule out Tuam as a possible source for the sherds. Following a suggestion by J. Chappell, however, Lilley (1988a:95–96) proposed that Type X could have been made on Huon Peninsula, possibly in the Sialum-Wandokai area.

Summerhayes (2000:175–192) analyzed the mineralogy of two Type X sherds from the FNY and FOH Lapita sites in the Arawe Islands and found that they differed from Lapita pottery and river sands on the south coast of New Britain. He concluded that the two sherds were "non-local to the south coast," but he did not suggest a possible source area (181).

RENEWED PETROGRAPHIC STUDY

Geological Framework

The northern coastal ranges of New Guinea are segments of a Paleogene island arc complex accreted tectonically to the New Guinea–Australia continental block. The latter was drawn into the evolving subduction zone of an arc-trench system that lay along the southern flank of an originally intraoceanic arc-trench system as it approached the continental block from the north and accreted progressively from west to east (Cullen and Pigott 1989; Pigram and Davies 1987). Ongoing subduction offshore along the axis of Huon Gulf and at the New Britain Trench along the northern margin of the Solomon Sea continues to draw Huon Peninsula and New Britain toward the Papuan Peninsula (Abers and McCaffrey 1994; Silver et al. 1991).

High ranges in the interior of Huon Peninsula are underlain by Oligocene to Lower Miocene Finisterre Volcanics (Jaques 1976), underlying Eocene oceanic crust, and Middle Eocene to Lower Miocene volcaniclastic strata derived from erosion of the Paleogene Finisterre volcanic arc (Abbott et al. 1994). Pre-mid-Miocene volcanogenic assemblages of Huon Peninsula are comparable in age and lithology to the Paleogene basement of central New Britain (Dickinson 2000), which is a generic continuation of the same island arc complex along the strike to the east. Streams draining to the eastern shore of Huon Peninsula head mostly in exposures of post-mid-Miocene limestone that overlie and dip northeast off the uplifted volcanogenic assemblages of the high ranges (Abbott et al. 1994; Jaques and Robinson 1977).

The geologic framework of Huon Peninsula suggests that terrigenous mineral sands are probably rare along its coast, where calcareous sands derived from offshore fringing reefs or eroded from limestone exposures inland are probably dominant. Noncalcareous sands are also unexpected in the Siassi Islands of emergent reef limestone, unless derived from pyroclastic blankets that could have been spread southward from nearby Umboi in the active Schouten volcanic arc.

Potential Huon-Siassi Tempers

Bedrock assemblages of both Paleogene and Neogene age from which sands could be derived along the Huon coast—or on Umboi and New Britain near the Siassi Islands—are thus all arc volcanic assemblages that should yield similar sands composed dominantly of plagioclase feldspar, augitic clinopyroxene, and volcanic lithic fragments (polycrystalline and polymineralic rock fragments) present in varying proportions dependent upon local sedimentological relations. There is no geological basis upon which the source of generically different mainland and island sands can be inferred. Therefore, no fundamental differences in temper composition can be expected, no matter where within its known distribution Type X was made, for local calcareous sands would also be indistinguishable petrographically. Local clays present along the Huon coast and within the Siassi Islands are likely to derive from similar parentage in the limestone substratum and therefore to be of similar composition as well. Sherd petrography is thus a blunt tool for sourcing Type X. Nevertheless, the unusual petrography of Type X sherds offers hints concerning their origin.

The Sample

This consisted of 28 sherds from 12 sites between Sio and Finschhafen and on Tuam and Malai Islands (Table 2). Lilley submitted 17 thin-section slides previously examined by Watchman, including 16 Type X sherds (4 from Tuam, 6 from Malai, and 6 from Sio). One sherd of late prehistoric Madang pottery from Sio, previously assigned by Watchman to the Yabob source near Madang, was included for comparative purposes. Specht's sample (n = 11) was selected to provide a wide geographical representation of Type X on Huon Peninsula. It consisted of sherds from the KAM open site near Finschhafen (1), two open and five cave sites at Sialum (8), and an open site at Gitua (2). These included sherds with obvious nonplastic inclusions and others without inclusions that stylistically fall within the range of Type X. Only one sherd was selected to represent KAM because the sherds collected there appeared in hand specimen to show no compositional variation. For comparison with the sherd mineralogy, we also included a sample of mineral beach sand from Kulabi village, west of Sio on the north coast of Huon Peninsula.

The sample included one incised body sherd and a plain Class 1 rim, both from the KLK site on Tuam Island, and a Class 1 rim with shell-impressed design (KCN/16) and two incised Class 2 rims (KDH, KDS/1C) from the Sialum area. These sherds and a selection of other Type X sherds that were not analyzed are illustrated in Figures 2 to 4.

Table 2. Results of Petrographic Analyses of 27 Type X Sherds and One Madang Style Sherd from Huon Peninsula and the Siassi Islands, Papua New Guinea

Area	Sherd code	Sherd type	Grog A	Grog B	Grog C	Grog D	Ferruginous	Sand
Siassi Islands								
Tuam (4)	KLK 5/1 (III/3)	body	x					
	KLK 7/1 (III/3)	body, incised		x				
	KLK 4/2 (III/2)	rim, class 1			x			
	KLK 10/1 (III/3)	body				x		
Malai (5)	KLJ 5/3 (I/1)	body		x				
	KLJ 5/4 (I/1)	body					x	
	KLJ 16/4 (I/2)	body					x	
	KLJ 28/1 (I/4)	body			x			
	KLJ 28/2 (I/4)	body	x					
Huon Peninsula								
Finschhafen (1)	KAM/33	body		x				
Sialum (8)	KCM/2	body	x					
	KCN/16	rim, class 1, shell imp					x	
	KCN/18	body	x					
	KCR/3	body						x
	KCV	body			x			
	KCX/1	body	x					
	KDH/5	rim, class 2, incised		x				
	KDS/1C	rim, class 2 incised					x	
Gitua (2)	KBZ/2/13	body			x			
	KBZ/2/14	body					x	
Sio (8)	KBQ 6/4 (I/2)	body, Madang						x
	KBQ 6/3 (I/2)	body		x				
	KBQ 15/1 (I/2–3)	body			x			
	KBQ 15/2 (I/2–3)	body					x	
	KBQ 23/4 (I/3)	body			x			
	KBQ 23/5 (I/3)	body					x	
	KBQ 28/3 (I/4)	body						x
	KBQ 28/4 (I/4)	body					x	
Totals (N = 28)			5	5	6	1	8	3

Note: Excavation contexts in parenthesis where relevant.

Type X Sherd Petrography

In general, Type X sherds contain a paucity of terrigenous (silicate and oxide) mineral grains derived from volcanic bedrock, and only a few contain calcareous grains. Systematic use of coastal sands as temper is thus precluded, and in this respect the Type X tempers are distinctly atypical for Oceanian sherd suites (Dickinson 1998; Dickinson and Shutler 2000).

Three broad groupings are identified, here termed grog-tempered, ferruginous-tempered, and sand-tempered. The three groups are gradational, without sharp divisions between them (Table 2). The distribution of the three gradationally

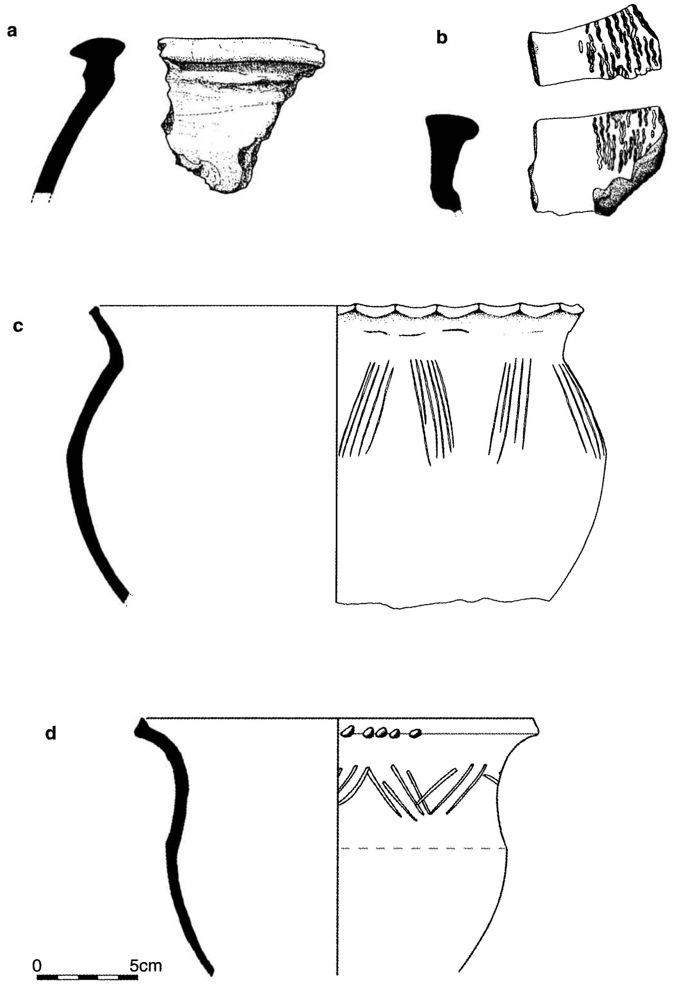

Fig. 2. Type X rim sherds studied in thin-section by Dickinson (vessel interior to right). a: KLK 4/2—Tuam Island (grog temper A), KLK/III, layer 2; b: KCN/16—Sialum, shell-impressed (ferruginous temper), surface; c: KDH/1-5—Sialum, incised (grog temper B), mouth diameter 260 mm, surface; d: KDS/1—Sialum, incised (ferruginous temper), mouth diameter 180–200 mm, surface.

related sherd types is thus fully compatible with the inference that the sherds derive from the same place on Huon Peninsula, although that place could have been a finite stretch of coast rather than one specific locale.

Grog-Tempered Sherds — The main temper grains in a majority of the Type X sherds (n = 17) are grog particles, broken pottery of medium to coarse sand size, discernible only as irregular domains with internal color, texture, or fabric that contrast with the surrounding clay paste. The grog particles occasionally are rounded to subrounded, while others are angular. The following four subgroups are recognized:

1. *Grog A:* Five sherds contain almost exclusively grog temper: KCM/2, KCN/18, KCX/1, KLK 5/1, and KLJ 28/2.

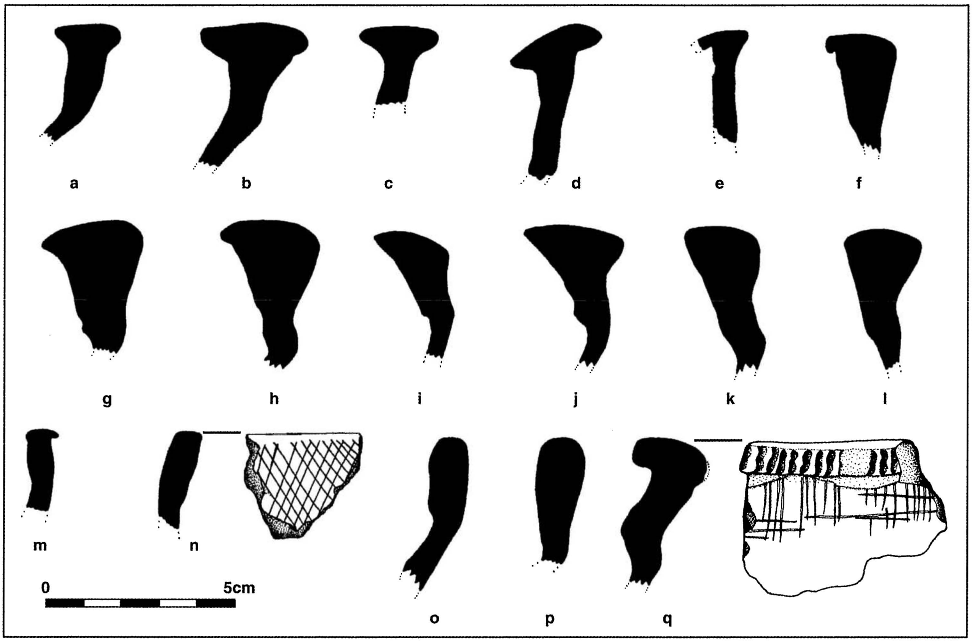

Fig. 3. Type X rims, all surface finds (orientations mostly unknown, vessel interior to right). a: KCX/2—Sialum; b: KAM/53—Finschhafen; c: KCR/17—Sialum; d: KCR/5-9-19—Sialum; e: KCR/12—Sialum; f: KAM/21—Finschhafen; g: KAM/14—Finschhafen; h: KAM/52—Finschhafen; i: FLE/I/1—Kandrian; j: KAM/19—Finschhafen; k: KAM/22—Finschhafen; l: KAM/18—Finschhafen; m: KCR/27—Sialum; n: KCR/13—Sialum, incised; o: KAM/29—Finschhafen; p: KAM/16—Finschhafen; q: KAM/15—Finschhafen, shell edge impressions on lip.

2. *Grog B:* Five sherds also contain subordinate ferruginous grains that serve to show generic continuity between the grog-tempered and ferruginous-tempered sherds of the Type X sherd suite: KAM/33, KDH/5, KBQ 6/3, KLK 7/1, and KLJ 5/3.

3. *Grog C:* Six sherds also contain subordinate terrigenous sand grains that document generic continuity between grog-tempered and sand-tempered sherds of the Type X sherd suite: KBQ 15/1, KBQ 23/4, KCV, KBZ/2/13, KLK 4/2, and KLJ 28/1.

4. *Grog D:* One sherd (KLK 10/1) from Tuam contains a few calcareous sand grains that were probably reworked from consolidated limestone rather than derived from contemporaneous reef detritus.

Ferruginous-Tempered Sherds — The next most abundant tempering agent in Type X sherds (n = 8) are subspherical to ovoid particles of medium to coarse sand size, composed largely of semiopaque iron oxides and probably derived from ferruginous pedogenic nodules in soils derived from subjacent limestone exposures. Subordinate grog particles are present in all the ferruginous-tempered sherds, however, and show that the grog-tempered and ferruginous-tempered sherds are but end members of a spectrum of related sherds. Two ferruginous-tempered sherds (KBQ 23/5 and KLJ 5/4) also contain subordinate terrigenous sand grains that tie the ferruginous-tempered Type X sherds generically to the sand-

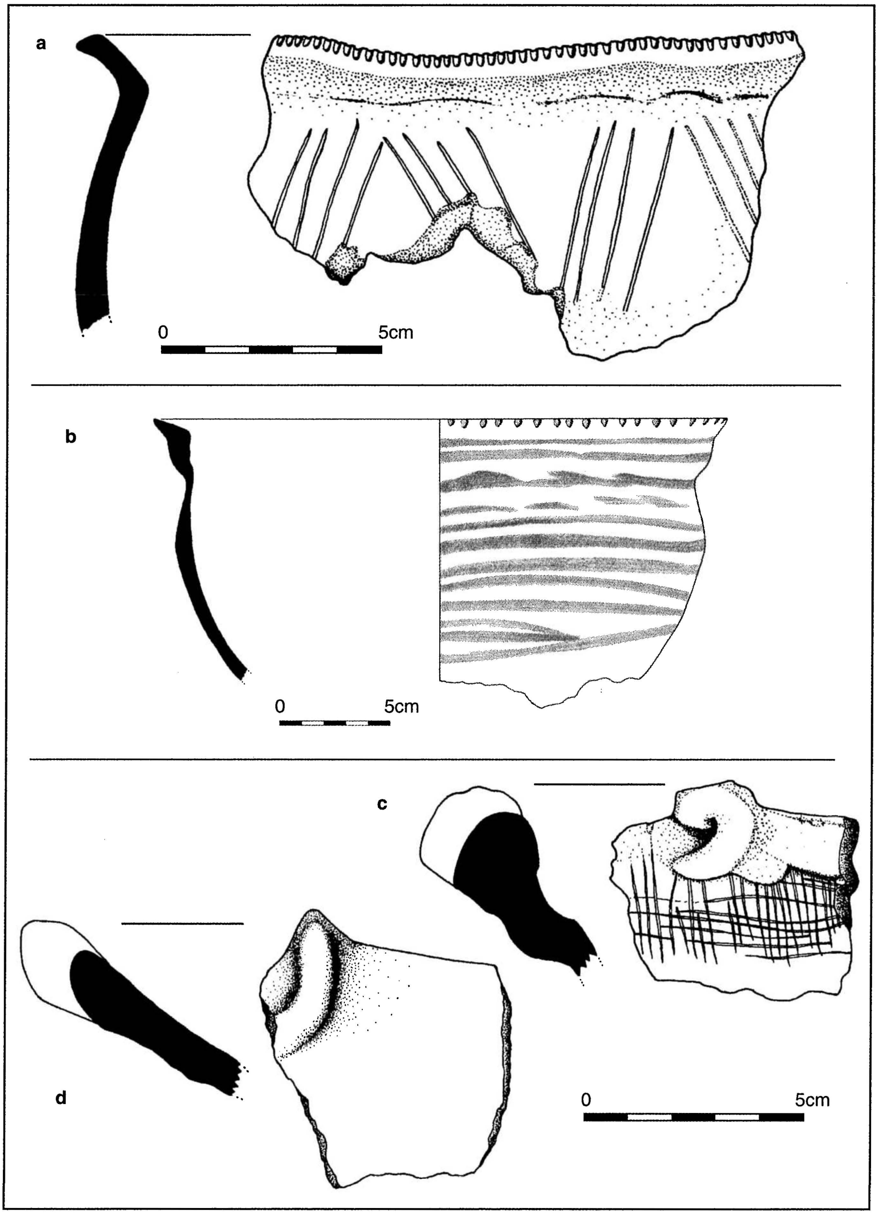

Fig. 4. Type X forms and rims, all surface finds. a: KDU—Sialum, incised with lip notching, mouth diameter 200 mm; b: KDV—Sialum, burnished with lip notching, mouth diameter 260 mm; c: KAM/26—Finschhafen, rim with lug; d: KAM/13—Finschhafen, rim with lug.

tempered Type X sherds as well. One of the ferruginous-tempered sherds from Sio (KBQ 15/2) contains subordinate calcareous grains composed at least in part of skeletal bioclastic debris and probably derived from beach sand including a component of contemporaneous reef detritus. Ferruginous-tempered sherds lacking any appreciable admixture of sand grains are KBQ 28/4, KBZ/2/14, KCN/16, KDS/1C, and KLJ 16/4.

Sand-Tempered Sherds — Two Type X sherds (KCR/3 and KBQ 28/3) and the Madang Style sherd (KBQ 6/4) contain subangular to subrounded terrigenous grains of fine to medium sand, but the sand is consistently mixed with subordinate grog particles that serve to tie these sherds generically to the rest of the Type X sherd suite. There were no sand-tempered sherds in the Siassi sample. While this may provide presumptive support for the inference that Type X derives from the Huon coast, the presence in the Siassi sample of ferruginous-tempered sherds containing subordinate terrigenous sand of the same general type as the sand-tempered sherds may indicate that the lack of sand-temper in the Siassi sherds that were sectioned simply reflects the overall paucity of this temper in the total sample studied here.

The principal sand grain types present in the sand-tempered sherds include, in approximate order of relative abundance, clinopyroxene (augite), plagioclase (feldspar), and volcanic rock fragments including a variety of textural and compositional types ranging from microlitic grains (with groundmasses of tiny plagioclase microlites set in volcanic glass), in part microporphyritic, to grains of altered brown volcanic glass (mafic). Subordinate grain types include opaque iron oxides (probably dominantly magnetite) and rare orthopyroxene (hypersthene) and hornblende. The mineral grains are all types common as phenocrysts in volcanic rocks of the Vitiaz Strait region (Jaques 1976; Johnson 1976), and the sands are all volcanic sands probably derived from Paleogene bedrock of Huon Peninsula, although derivation from the Neogene volcanic chain of the Schouten arc cannot be ruled out on geological grounds. The pyroxene-rich character of the terrigenous sands implies probable origin as local beach placers (Dickinson 1994).

Kulabi Beach Sand — This is a moderately sorted (fine to coarse) but strongly placered sand composed of subrounded to subangular grains of modestly hybrid character (terrigenous grains mixed with <10 percent calcareous grains of reef detritus). Table 3 compares the composition of the terrigenous fraction of the sand

TABLE 3. FREQUENCY PERCENTAGES OF GRAIN TYPES IN THREE SAND-TEMPERED SHERDS AND IN THE TERRIGENOUS FRACTION OF KULABI BEACH SAND, HUON PENINSULA, PAPUA NEW GUINEA, BASED ON AREAL COUNTS OF "N" GRAINS IN THIN SECTION

GRAIN TYPE	KCR/3 (TYPE X)	KBQ 28/3 (TYPE X)	KBQ 6/4 (MADANG)	SHERD AVERAGE	KULABI SAND
Plagioclase feldspar	25	12	11	16	0
Clinopyroxene	63	80	68	70	77
Orthopyroxene	1	1	1	1	1
Hornblende	1	1	trace	1	0
Olivine	0	0	0	0	1
Opaque iron oxides	3	2	6	4	1
Volcanic rock fragments	7	4	14	9	20
microlitic	3	2	6	4	17
glassy	4	2	8	5	3
Counts	123	669	653		515

with the less placered volcanic sands that occur as terrigenous temper mixed with grog particles in three Huon sherds. The respective sands are similar but not identical. Contrasts in hornblende and olivine content may derive from the statistics of small numbers or operator variance and probably do not reflect any significant difference in the source rocks for the sands. The higher plagioclase content of the temper sands may reflect locally more intense placering for the Kulabi beach sand. The higher content of volcanic rock fragments in the Kulabi sand may reflect simply its coarser grain size, as these fragments tend to be larger in diameter than the clinopyroxene mineral grains.

Discussion

There is no obvious preferential spatial distribution between the sites of the variants of the grog-tempered sherds or those with ferruginous temper. On the other hand, when the Type X localities are treated as four areal groups (Siassi, Finschhafen, Sialum, and Sio-Gitua), there is a hint of patterning. Siassi is the only area where all four grog-tempers occur (nine sherds), and this reduces to three around Sialum (eight sherds) and two at Sio-Gitua (ten sherds). Grog B is the only temper group that occurs in all four areas, though several occur in three areas. The ferruginous and sand tempers and possibly some of the grog-tempers are probably absent from Finschhafen, where the Type X sherds display uniform composition in hand specimens and probably all belong to the Grog B group. Given the small samples from each area, however, sample bias cannot be ruled out and may explain the absence of Grog A at Sio and Gitua and the presence of Grog D only on Tuam.

On present data, the tempers do not provide a guide to the place or places of Type X pottery manufacture, but are not inconsistent with a Huon Peninsula origin. As Type X pottery was transported widely around the Vitiaz Strait area, the sand temper in some sherds may also have been transported from unknown locales to the place or places of pottery making, although its composition is not obviously exotic. The sand temper in the protohistoric Madang sherd from Sio (KBQ 6/4), which shares with Type X the use of grog (though in reduced amounts), is not generically different from the sand tempers in Type X sherds from the Huon coast. This may indicate an origin on Huon Peninsula similar to that of Type X rather than the Madang area itself, though Watchman (1986:512, 531) assigned this sherd to the same source as a modern potter's clay mix at Yabob. On balance, the Kulabi beach sand is not a close match for the sherd temper sands, but their generic similarity does not preclude the conclusion that the sherd tempers may derive from sand collected somewhere on the coast of the Huon Peninsula.

The number of sherds is too small to suggest any patterning between temper type and aspects of form or decoration. The sample included four rims, two each of Class 1 and Class 2 (see Fig. 2). The Class 1 rim from Tuam (KLK 4/2) is assigned to the Grog C group and that from Sialum (KCN/16—shell impressed) to the Ferruginous group. The Class 2 rim sherds from Sialum are assigned to Grog B (KDH/5—incised) and the Ferruginous group (KDS 1/C—incised). The relationship between the two rim classes is unknown, but the compositional variation between these sherds might indicate different places of manufacture. The two incised sherds from Tuam and Sialum are both assigned to the Grog B group.

The independent recognition of grog temper by Watchman and Dickinson is the first confirmation of the use of this temper category in the New Guinea region in either prehistoric or recent pottery (May and Tuckson 1982; Rye 1976). The nearest occurrence of the technique is in Palau, western Micronesia, where Osborne (1966:33) recorded crushed sherds as a tempering agent in recent times. The grog particles in Type X might similarly have derived from sherds or from fired clay prepared specifically to produce grog particles when smashed.

An alternative possibility for the origin of the grog temper might be the use of natural materials that present the appearance of crushed sherds on firing, though testing of this would require extensive field studies and experimentation beyond the scope of our present study. May and Tuckson (1982:98, 150, 152, 238, 310) recorded the use of two or more clays in several contemporary Papua New Guinea industries. Some potters on Tumleo Island, in the Aitape area of West Sepik Province, for example, use a clay mix consisting of three ingredients, one of which has a low clay mineral content and might be more appropriately termed a temper (310–311). This third ingredient is sun-dried, crushed, and dry-sieved before the fine fraction is added to the other two clays. Through the courtesy of John Terrell (Field Museum, Chicago), we have examined 50 sherds from the Aitape coast, including seven from Tumleo. This sherd suite contains terrigenous temper sands of complex mineralogy, notably including quartz grains, derived ultimately from the diverse igneous, metamorphic, and sedimentary rock assemblages of the nearby mountainous hinterland. Both natural and manually added tempers are present in the Aitape sherds, including those from Tumleo, but none contains grog or groglike particles.

The use of grog temper in the Type X pots contrasts with the contemporary pottery technologies of Huon Peninsula and the Madang area. The potters of Sio, Gitua, and Sialum on Huon Peninsula do not temper their clay, although those of Sio No. 2 and Nambariwa near Sio mix two clays to produce their potting mix. Indeed, Sio, Gitua, and Sialum are the only pottery centers using the paddle-and-anvil technique in contemporary Papua New Guinea that do not add a temper (May and Tuckson 1982:152). The Madang potters use several clays to which they add beach sands as temper (169–171).

Petrography does not reveal why only grog was added to some Type X clay bodies, whereas ferruginous grains or terrigenous sand as well as grog were added to others. It might reflect relative ease of access to ferruginous concentrates in or on residual soil profiles and to placer sand deposits at different sites of Type X pottery manufacture. Alternatively, variation between individual potters might have come into play. The fact that modern potters of Sio, Gitua, and Sialum find no need to add a temper suggests that its use in the past was probably culturally rather than technologically driven. It is unlikely to have resulted from the use of clay sources different to those used today, as Watchman (1986:528) suggested that a Type X sherd with Grog C (KBQ 15/1) might have been made from a contemporary Sio clay source.

Additional work is clearly required on the issue of grog temper and Type X technology. Here we retain the term "grog" without defining its specific origin and note that this technology appears to have been a fundamental characteristic of Type X production, which may account for the unique nature of this pottery within the region. Furthermore, the use of grog in some Ancestral Sio and Madang pottery as well as in Type X raises the possibility of a developmental or historical relationship between them.

A POSSIBLE MICRONESIAN ORIGIN FOR TYPE X

In his formulation of Type X, Lilley (1988a:94) noted general visual similarities between Type X and Laminated pottery on Yap in Micronesia. At that time, Yap Laminated ware was insecurely dated (Intoh 1984), but more recent work now places its beginning around 650 cal. B.P., toward the end of Type X (Descantes 2002:229; Intoh 1990, 1992:75). Furthermore, the vessel shapes of Yap Laminated pottery are unlike those of Type X, and its distinctive laminated structure is probably the result of wetting the pots prior to firing (Intoh 1988:121, 1990:47). The superficial similarity between Type X and this Yap pottery is therefore rejected, and our focus is on the use of grog temper.

Hitherto, grog temper in past or recent Pacific pottery industries has been recognized only in pottery made in Palau, Yap, and Pohnpei in Micronesia (Athens 1990a; Ayres 1990; Dickinson and Shutler 2000:215; Fitzpatrick et al. 2003; Intoh and Dickinson 2002; Osborne 1966:35–37). Dickinson (1993) once proposed its use in American Samoa but now regards this as unlikely. The use of grog temper in Micronesia started about 2400 years ago in Palau (Clark 2004:27–28, in review; Intoh 1992:75) and around 2000 cal. B.P. on Yap (Intoh 1990:44) and Pohnpei (Ayres 1990:190). It continued in Palau until recent times (Osborne 1966:35–37) but ended in Yap around 600–650 cal. B.P. (Intoh 1990:44) and in Pohnpei around 1000–750 cal. B.P. (Athens 1990a:26; Ayres 1990:190).

There is thus a long history of grog temper in Palau, Yap, and Pohnpei extending back at least one millennium before the appearance of Type X and overlapping with most of its known span. We have argued above that the use of grog temper in Type X was probably culturally rather than technologically driven and, as there is currently no likely antecedent for Type X on the north coast of New Guinea, we raise the possibility that the sharing of the unusual grog temper technology between Type X and the Palau, Yap, and Pohnpei industries might indicate contact between one or more of those northerly centers and the Huon Peninsula region. Of particular interest here is the presence in Palau of four grog and composite tempers forming "gradational types" within a "single temper spectrum" (Fitzpatrick et al. 2003:1179), a situation remarkably similar to that found with Type X tempers. In both areas, grog was one of several options for temper. We now turn to the evidence from vessel forms.

We noted above the lack of correspondence between Type X forms and those of Yap Laminated pottery, and this seems to hold for earlier Yapese pottery (Intoh 1988: Fig. 6; Intoh and Leach 1985: Figs. 30–32). Similarly, the pottery from Pohnpei, which ended just after Type X began, bears no resemblance to Type X (e.g., Athens 1990a; Ayres 1990). The closest similarities are between Type X and pottery from Palau. The Class 1 T-shaped rim forms of Type X (Lilley 1988a:92) are similar to some Palauan forms (compare Figs. 2–4 with Clark in review: Fig. 4; Clark and Wright 2003: Fig. 3 upper and middle; Hayakawa 1979: Fig. 9; Intoh 1981: Fig. 3; Osborne 1966: Fig. 15; Takayama 1979: Figs. 4–5; Takayama et al. 1980: Figs. 7–10). On Ulong Island, the Palauan examples start around 1000 cal. B.P. (Clark in review: Table 1). This is consistent with dates of probably not older than 1150–850 cal. B.P. on Kayangel Atoll (Takayama et al. 1980: Table 1, N-3369) and about 750 cal. B.P. or later on Ngarenggol (Takayama 1979:90). In each case the dates fall within the time range of Type X of about 1000 to 500 cal. B.P. There are thus similarities of both form and temper technology between Type X and Palauan pottery of the same period. We note, however, that lugged rims similar to those of Type X at KAM (Figs. 4c, 4d) appear to be absent from Palau (for undated non-Type X examples on Huon Peninsula, see Abramson 1969: Plate IIa for the Tami Islands; Keysser 1911: Fig. 64 for Jabim Mission). With this exception, we suggest that Type X might have had its origin in the Palau group.

The distance between Huon Peninsula and the Micronesian islands producing grog-tempered pottery is at least 2000 km. The western end of New Guinea, however, lies about 1200 km from Yap and about 700 km from the main islands of Palau. Nuclear Micronesian (Chuukic) languages are or were once spoken on the most southerly islands of the Palau group, which extend to within about 100 km of the western end of New Guinea (Marck 1986; Wurm and Hattori 1981: Map 18). That this short distance was crossed is indicated by the similarities between the rock art of Palau and parts of New Guinea (Rainbird 2004:49, 146). Within Micronesia, the transport of Yapese and Palauan grog-tempered pottery to other islands began about 1900 years ago, with pottery from both sources traveling up to 700 km (Descantes 2002; Intoh 1992:80; Intoh and Dickinson 2002:127). This widespread movement might have been tied up with the development of the *sawei* exchange system and/or the export of the limestone discs (stone money) from Palau to Yap around 1000–1450 years ago (Fitzpatrick 2002; Rainbird 2004:160). With such a long history of sea travel within western Micronesia, deliberate or accidental voyages along the north coast of New Guinea and to the Bismarck Archipelago seem highly probable (cf. Marck 1986; Spriggs 1997:189–192). Contacts in the reverse direction, particularly from New Guinea to Palau, are also likely in light of mtDNA data (Lum and Cann 2000:165–166).

In his study of Pacific exploration and colonization, Irwin (1992) did not present computer simulations of voyages from the Palau area, but his Figures 41 and 42 of wind patterns in January and July suggest that deliberate two-way voyages from the Palau group to New Guinea and the Bismarck Archipelago were possible. Records of one-way accidental voyages support this. A drift voyage from Palau reached the Mortlock Islands to the northeast of Bougainville, a distance of about 2400 km, and five men survived a voyage of about the same distance from eastern Indonesia to the Witu Islands off the north coast of New Britain (Anon. 1962: voyages 148, 152). Assuming that the potters of Palau at the time of Type X were female, as are the contemporary potters of Palau (Osborne 1966:32) and Sio-Gitua-Sialum and Madang (May and Tuckson 1982), women must have been involved in the contact that introduced Type X to Huon Peninsula. This interpretation is supported by the fact that many drift voyages included women, and a young female survivor on the Palau canoe that reached the Mortlocks married a local man.

OTHER POSSIBLE MICRONESIAN LINKS

There are other possible indicators of contacts between parts of Micronesia and the north coast of New Guinea, although these do not all involve Palau. The linguistic evidence is limited but evocative. The area covered by Type X primarily has Austronesian languages of the North New Guinea (NNG) Linkage (Ross 1988:120–189; Ross et al. 2003: Map 4). Several of these NNG languages (Adzera, Sio, Gitua) have a reflex of POc **kuron* for "cooking pot" (May and Tuckson 1982:152; Osmond and Ross 1998:68; Ross 1996a:70). In contrast, others (e.g., Mapos-Buang and Patep *dɛg* "cooking pot"; Bilibil *daig* "dish") have reflexes of POc **d(r)ag(i)* for "container," which "is apparently reflected only in Yapese [= coconut-shell container] and NNG languages," though it is not clear whether this is a retention or a borrowing (Osmond and Ross 1998:75; gloss in square brackets added).

The Madang coast and the Manus group are the only parts of north New Guinea and the Bismarck Archipelago where kava drinking was practiced. Drawing on linguistic and botanical evidence, Crowley (1994; cf. Spriggs 1997:191–192) suggests that kava drinking began in the Vanuatu area, whence it was taken via West Polynesia to Kosrae and Pohnpei and eventually to Manus and the Madang coast. There is no indication when this occurred (for an alternative view for Manus, see Ambrose 1991).

The Huon Gulf–Finschhafen area is one of the few parts of the New Guinea region where compound fishhooks with a shell lure shank occur (Anell 1955:145–147, Fig. 12 right; Neuhauss 1911 vol. 1: Fig. 190c–d; Nordhoff 1930). Such hooks are common in the Solomon Islands (Bell et al. 1986), the likely source for some compound fishhooks of Micronesia (Palau: Takayama 1979:96; Fais: Intoh 1991:11–12; Pohnpei: Ayres 1990:191; Majuro: Weisler 2000:128–131). The recent Huon Gulf–Finschhafen forms differ from those of the Solomons and Micronesia, but a shank fragment with a knobbed line attachment and incised line decoration found in layer 2 of KBQ/I at Sio recalls early Micronesian examples (Lilley 1986:382, Fig. 9.16). This Sio example is dated toward the end of Type X at 700–540 and 660–430 cal. B.P. (ANU 4332 and ANU 4990 respectively; both samples are marine shell, calibrated by Calib. Rev. 4.4.2, with Delta $R = 0 \pm 0$; Stuiver et al. 1998a, 1998b; Stuiver and Reimer 1993). A similar shank, made from *Pinctada* shell and with a knobbed line attachment and incised line decoration, was found with a Type X sherd in rock shelter KIC to the south of Sialum (Araho 1995:31, Fig. 8). This level is undated, but an age similar to that at Sio seems reasonable. In Micronesia such shanks appeared somewhat earlier at 1500–1200 cal. B.P. on Fais, and ~1200 cal. B.P. on Majuro, Pohnpei, and Kosrae (Intoh 1999:415–416), though Ayers (1990:191) and Weisler (2000:128) suggest slightly earlier dates for Pohnpei and Majuro. While a Solomon Islands source for the Huon Gulf–Finschhafen fishhooks cannot be ruled out, the presence of comparable forms in Kosrae and Pohnpei adds to the argument for past contact between these islands and the north coast of New Guinea indicated by the kava evidence. Gillett (1987:12) records that "very old Satawalese fishermen spoke of a reef near New Guinea" that was a source of *Pinctada maxima* shell for making fishing lures on Satawal to the east of the Palau group, but it is not clear from his account whether the importing of this shell to Satawal existed before the arrival of Japanese divers in the twentieth century.

We noted earlier the claim for similarities between rock art in the Palau group and that of the western end of New Guinea (Rainbird 2004:145–146). There are also similarities between Palauan rock paintings and those of the Manus Islands in the Bismarck Archipelago and between engravings of the "enveloped cross" motif at Pohnpaid on Pohnpei and similar forms in Island Melanesia (Rainbird 2002:144, 2004:196; Wilson 2002:78–79). In the Vanuatu area, the "enveloped cross" is assigned to the Rectilinear rock art tradition, which began about 1000 years ago (Wilson 2002:222), though an earlier date is possible (Rainbird and Wilson 2002:636). At this stage, however, we see no specific similarities between Type X designs or the rock art of Huon Peninsula and rock art in Micronesia.

Other evidence for contact between Micronesia and the New Guinea region relates to the northern islands of the Bismarck Archipelago, where there are indications of links between languages of the Manus area and those of Nuclear Micronesian and Yapese, though the case of Yapese itself is highly complex (Ross 1988:326–329, 1996b). There are also the backstrap loom in the Mussau Islands (Parkinson 1999:143, 148) and the "Micronesian" material culture of Aua and Wuvulu Islands in Manus Province (Hambruch 1908; Parkinson 1999:183–197), although Rainbird (2004:150) introduces a caution about the antiquity of this latter situation. In the reverse direction, an obsidian point fragment found on Pohnpei is said to be similar to those of Manus (Ayres and Mauricio 1987: Fig. 4; Rainbird 2004:186; Spriggs 1997:128). Finally, modern Manus obsidian has been reported in the Marshall Islands, most likely as a result of floating volcanic debris (Spennemann and Ambrose 1997).

CONCLUSIONS

Our study supports the view that Type X was probably made on Huon Peninsula, without identifying a specific place or region, and confirms the use of a range of grog and other tempers. The use of grog temper cannot be ascribed to the nature of the raw materials available, as the modern potters of Sio-Gitua-Sialum do not add temper to their clays, and thus a cultural reason for its use seems likely. Comparisons with the pottery of Palau, Yap, and Pohnpei—the only other areas of the western Pacific where grog temper is known—lead to the tentative conclusion that grog-tempered pottery was introduced to Huon Peninsula through contacts with Palau that involved the transfer of potters between the two areas.

The diverse evidence for contacts between other parts of Micronesia and the New Guinea region lend support to this suggestion. In no instance is there need to invoke large-scale movements of people; rather, there were probably many small-scale interactions, perhaps as a result of unintentional voyaging at different times and from different points. A similar situation has been suggested for the origin of pottery of Kosrae, Pohnpei, and Chuuk. Athens (1990a:29, 1995:268) accepts the general view of derivation from Late Lapita or Post-Lapita Transition pottery, but he broadens the possible source area beyond the traditional view of a source area in the southeast Solomons and northern Vanuatu and allows for different islands to have been settled from different origin points within the Lapita distribution.

If our interpretation of the origins of Type X is sustainable, it may contribute to explaining the complex cultural picture of the Huon Peninsula–Huon Gulf region obtained through ethnographic and linguistic studies. The region has witnessed many small-scale population movements (Chowning 1986; Harding 1967:12–13) that resulted in what Bradshaw (1997) has called a "population kaleidoscope," in which clear-cut cultural boundaries do not exist between communities (Bradshaw 2001; cf. Welsch and Terrell 1998 for another part of the north coast of New Guinea). The largest settlement within the distribution of Type X, outside the township of Finschhafen, is Sio on the northeastern corner of Huon Peninsula. Ostensibly a single ethnolinguistic community, Sio is in fact a community of many origins within which the "theme of Sio history is unity out of diversity" (Harding and Clark 1994:36).

Parallel to this complexity of community histories is the constant movement of goods between different parts of Huon Peninsula and Huon Gulf, throughout which pottery was traded widely in recent times. In 1969 Specht saw pots from the Watut Valley, Sio-Gitua-Sialum, and Huon Gulf in Supang village, inland from Finschhafen, and Lilley (1986:67, Fig. 3.6) later recorded both Sio-Gitua-Sialum and Huon Gulf vessels in Wandokai village, between Sialum and Finschhafen on the Huon coast. The diversity of pottery styles represented in Abramson's 1969 collection from the Tami Islands reflects a similar situation of overlapping distributions in the period when the Tami Islands were a major center of trade. The possible origin of Type X that we have proposed here adds a further dimension to this complexity by introducing the vagaries of historical contingency. It may prove extremely difficult, at times perhaps impossible, to identify in the archaeological record the history of individual cultural elements, each of which is likely to have had "its own history, its own spatial and temporal distribution" (Terrell and Welsch 1997:565, 568).

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REFERENCES

Abbott, L. D., E. A. Silver, and J. Galewsky
1994 Structural evolution of a modern arc-continent collision in Papua New Guinea. *Tectonics* 13:1007–1034.

Abers, G. A., and R. McCaffrey
1994 Active arc-continent collision: Earthquakes, gravity anomalies, and fault kinematics in the Huon-Finisterre collision zone, Papua New Guinea. *Tectonics* 13:237–245.

Abramson, J.
1969 A preliminary archaeological survey of the Tami Islands, Territory of New Guinea. *Archaeology and Physical Anthropology in Oceania* 4(2):83–90.

AMBROSE, W.
1991 Manus, mortars and the kava connection, in *Oceanic Culture History: Essays in Honour of Roger Green:* 461–469, ed. J. Davidson, G. Irwin, B. F. Leach, A. Pawley, and D. Brown. Dunedin: New Zealand Journal of Archaeology.

ANELL, B.
1955 *Contribution to the History of Fishing in the Southern Seas.* Studia Ethnographica Upsaliensia 9. Uppsala: University of Uppsala.

ANON
1962 A Table of accidental and deliberate voyages in the South Pacific, in *Polynesian Navigation: A Symposium on Andrew Sharp's Theory of Accidental Voyages:* 137–153, ed. J. Golson. Wellington: Polynesian Society.

ARAHO, N.
1995 Results of the Excavation of Two Sea Cut Caves in the Holocene Reef Face at Wandokai, Finschhafen District, Morobe Province, Papua New Guinea. Unpubl. B.A. (Hons) thesis. University of Papua New Guinea, Waigani.

ATHENS, J. S.
1990a Nan Madol pottery, Pohnpei. *Micronesica* Supplement 2:17–32.
1990b Kosrae pottery, clay and early settlement. *Micronesica* Supplement 2:171–186.
1995 *Landscape Archaeology: Prehistoric Settlement, Subsistence and Environment of Kosrae, Eastern Caroline Islands, Micronesia.* Honolulu: International Archaeological Research Institute.

AYRES, W. S.
1990 Pohnpei's position in Eastern Micronesian prehistory. *Micronesica* Supplement 2:187–212.

AYRES, W. S., AND R. MAURICIO
1987 Stone adzes from Pohnpei, Micronesia. *Archaeology in Oceania* 22(1):27–31.

BAYARD, D.
1976 *The Cultural Relationships of the Polynesian Outliers.* Studies in Prehistoric Anthropology 9. Dunedin: Department of Anthropology, Otago University.

BELL, D., J. SPECHT, AND D. HAIN
1986 Beyond the reef: Compound fishhooks in the Solomon Islands, in *Traditional Fishing in the Pacific: Ethnographic and Archaeological Papers from the 15th Pacific Science Congress:* 45–63, ed. A. Anderson. Pacific Anthropological Records 37. Honolulu: Bishop Museum.

BLUST, R.
1984 Malaita-Micronesian: An Eastern Oceanic subgroup? *Journal of the Polynesian Society* 93(2):99–140.

BRADSHAW, J.
1997 The population kaleidoscope: Another factor in the Melanesian diversity v. Polynesian homogeneity debate. *Journal of the Polynesian Society* 106(3):222–249.
2001 Language, culture, and community boundaries around the Huon Gulf of New Guinea, in *Archaeology, Language and History: Essays on Culture and Ethnicity:* 283–306, ed. J. E. Terrell. Westport, CT: Bergin and Garvey.

CHOWNING, A.
1986 Refugees, traders, and other wanderers: The linguistic effects of population mixing in Melanesia, in *FOCAL II: Papers from the Fourth International Conference on Austronesian Linguistics:* 407–434, ed. P. Geraghty, L. Carrington, and S. A. Wurm. Pacific Linguistics C-94. Canberra: Department of Linguistics, Australian National University.

CLARK, G.
2004 Radiocarbon dates from the Ulong site in Palau and implications for Western Micronesian prehistory. *Archaeology in Oceania* 39(1):26–33.
In review A 3000-year culture sequence from Palau, Western Micronesia. Submitted to *Asian Perspectives.*

CLARK, G., AND D. WRIGHT
2003 The colonisation of Palau: Preliminary results from Angaur and Ulong, in *Pacific Archaeology: Assessments and Prospects:* 85–94, ed. C. Sand. Les Cahiers de l'Archéologie en Nouvelle-Calédonie 15. Noumea: Départment Archéologie, Service des Musées et du Patrimoine de Nouvelle-Calédonie.

Crowley, T.
1994 Proto who drank kava? in *Austronesian Terminologies: Continuity and Change:* 87–100, ed. A. Pawley and M. D. Ross. Pacific Linguistics C-127.Canberra: Department of Linguistics, Australian National University.

Cullen, A. B., and J. D. Pigott
1989 Post-Jurassic tectonic evolution of Papua New Guinea. *Tectonophysics* 162:291–302.

Descantes, C.
2002 The history of exchange between Yap and Ulithi, Western Caroline Islands. Unpubl. paper presented at the 17th Congress of the Indo-Pacific Prehistory Association, Taipei, September 2002.

Dickinson, W. R.
1993 Sand temper in prehistoric potsherds from the To'aga site, in *The To'aga Site: Three Millennia of Polynesian Occupation in the Manu'a Islands, American Samoa:* 151–156, ed. P. V. Kirch and T. L. Hunt. Contribution 51. Berkeley: Archaeological Research Facility, University of California.
1994 Natural beach placer analogous to prehistoric island tempers. *Journal of the Polynesian Society* 103(2):217–219.
1998 Petrographic temper provinces of prehistoric pottery in Oceania. *Records of the Australian Museum* 50(3):263–276.
2000 Petrography of sand tempers in prehistoric Watom sherds and comparison with temper suites of the Bismarck Archipelago. *New Zealand Journal of Archaeology* 20 (1998):161–182.

Dickinson, W. R., and R. Shutler Jr.
2000 Implications of petrographic temper analysis for Oceanian prehistory. *Journal of World Prehistory* 14:203–266.

Fitzpatrick, S. M.
2002 A radiocarbon chronology of Yapese stone money quarries in Palau. *Micronesica* 34(2):227–242.

Fitzpatrick, S. M., W. R. Dickinson, and G. Clark
2003 Ceramic petrography and cultural interaction in Palau, Micronesia. *Journal of Archaeological Science* 30:1175–1184.

Gifford, E. W., and D. S. Gifford
1959 Archaeological excavations in Yap. *Anthropological Records* 18(2):149–224.

Gillett, R.
1987 *Traditional Tuna Fishing: A Study at Satawal, Central Caroline Islands.* Bulletin in Anthropology 1. Honolulu: Bishop Museum.

Gosden, C., and C. Pavlides
1994 Are islands insular? Landscape vs. seascape in the case of the Arawe Islands, Papua New Guinea. *Archaeology in Oceania* 29(3):162–171.

Hambruch, P.
1908 Wuvulu und Aua (Maty- und Durour-Inseln) auf Grund der Sammlung F. E. Hellwig aus den Jahren 1902–1904. *Mitteilungen aus dem Museum für Völkerkunde, Hamburg* 2(1).

Harding, T. G.
1967 *Voyagers of the Vitiaz Strait: A Study of a New Guinea Trade System.* Monograph 44. Seattle: University of Washington Press.

Harding, T. G., and S. A. Clark
1994 The Sio story of Male. *Pacific Studies* 17(4):29–51.

Hayakawa, S.
1979 Archaeological investigations of PAKR-3 in the Palaus, in *Report: Cultural Anthropological Research on the Folk Culture in the Western Caroline Islands of Micronesia in 1977:* 73–78, ed. H. Kusakabe. Tokyo: Committee for Micronesian Research, Tokyo University of Foreign Studies.

Intoh, M.
1981 Reconnaissance archaeological work on Ngulu Atoll in the Western Caroline Islands. *Asian Perspectives* 24(1):69–80.
1984 Yapese pottery: Review and problems. *The Outrigger* 3(1):2–3.

1988 Changing Prehistoric Yapese Pottery Technology: A Case Study of Adaptive Transformation. Unpubl. Ph.D. diss. University of Otago, Dunedin.

1990 Ceramic environment and technology: A case study in the Yap Islands in Micronesia. *Man and Culture in Oceania* 6:35–52.

1991 *Archaeological Research on Fais Island: Preliminary Report.* Tokyo: Department of International Cultural Relations, Hokkaido Tokai University.

1992 Pottery traditions in Micronesia, in *Poterie Lapita et Peuplement:* 67–82, ed. J.-C. Galipaud. Noumea: ORSTOM.

1996 Multi-regional contacts of prehistoric Fais Islanders in Micronesia. *Bulletin of the Indo-Pacific Prehistory Association* 15:111–117.

1997 Human dispersals in Micronesia. *Anthropological Science* 105(1):15–28.

1999 Cultural contacts between Micronesia and Melanesia, in *The Pacific from 5000 to 2000 B.P.: Colonisation and Transformations:* 407–422, ed. J.-C. Galipaud and I. Lilley. Noumea: Institute de Recherche pour le Dévelopement.

Intoh, M., and W. R. Dickinson

2002 Prehistoric pottery movements in western Micronesia: Technological and petrological study of potsherds from Fais Island, in *Fifty Years in the Field: Essays in Honour of Richard Shutler Jr's Archaeological Career:* 123–134, ed. S. Bedford, C. Sand, and D. Burley. Monograph 25. Auckland: New Zealand Archaeological Association.

Intoh, M., and F. Leach

1985 *Archaeological Investigations in the Yap Islands, Micronesia.* British Archaeological Reports, International Series 277.

Irwin, G.

1992 *The Prehistoric Exploration and Colonisation of the Pacific.* Cambridge, UK: Cambridge University Press.

Jaques, A. L.

1976 High-K_20 island-arc volcanic rocks from the Finisterre and Adelbert Ranges, northern Papua New Guinea. *Geological Society of America Bulletin* 87:861–867.

Jaques, A. L., and G. P. Robinson

1977 The continent/island-arc collision in northern Papua New Guinea. *BMR Journal of Australian Geology and Geophysics* 2:289–303.

Johnson, R. W.

1976 Late Cainozoic volcanism and plate tectonics at the southern margin of the Bismarck Sea, Papua New Guinea, in *Volcanism in Australasia:* 101–116, ed. R. W. Johnson. Amsterdam: Elsevier.

Keysser, C.

1911 Aus Leben der Kaileute, in *Deutsch-Neu-Guinea* vol. 3:3–242, ed. R. Neuhauss. Berlin: Dietrich Reimer A. G.

Lilley, I.

1986 Prehistoric Exchange in the Vitiaz Strait, Papua New Guinea. Unpubl. Ph.D. diss. Australian National University, Canberra.

1988a Type X: Description and discussion of a prehistoric ceramic ware from northeastern Papua New Guinea. *Bulletin of the Indo-Pacific Prehistory Association* 8:90–100.

1988b Prehistoric exchange across the Vitiaz Strait, Papua New Guinea. *Current Anthropology* 29:513–516.

1991 Lapita and Post-Lapita developments in the Vitiaz Straits–West New Britain area. *Bulletin of the Indo-Pacific Prehistory Association* 11:313–322.

2002 Lapita and Type Y in the KLK site, Siassi, Papua New Guinea, in *Fifty Years in the Field: Essays in Honour of Richard Shutler Jr's Archaeological Career:* 79–90, ed. S. Bedford, C. Sand, and D. Burley. Monograph 25. Auckland: New Zealand Archaeological Association.

2004 Trade and culture history across the Vitiaz Strait, Papua New Guinea: The emerging Post-Lapita coastal sequence. *Records of the Australian Museum,* Supplement 29:89–96.

Lilley, I., and J. Specht

In review Revised dating of Type X pottery, Papua New Guinea. Submitted to the *Records of the Australian Museum.*

Lum, J. K., and R. L. Cann

2000 mtDNA lineage analyses: Origins and migrations of Micronesians and Polynesians. *American Journal of Physical Anthropology* 113:151–168.

Marck, J. C.
1986 Micronesian dialects and the overnight voyage. *Journal of the Polynesian Society* 95(1):253–258.

May, P., and M. Tuckson
1982 *The Traditional Pottery of Papua New Guinea.* Sydney: Bay Books.

Neuhauss, R.
1911 *Deutsch-Neu-Guinea.* 3 vols. Berlin: Dietrich Reimer A. G.

Nordhoff, C.
1930 Notes on the off-shore fishing of the Society Islands. *Journal of the Polynesian Society* 39(3):221–262.

Osborne, D.
1966 *The Archaeology of the Palau Islands.* Bulletin 230. Honolulu: B. P. Bishop Museum.

Osmond, M., and M. Ross
1998 Household artefacts, in *The Lexicon of Proto Oceanic: The Culture and Environment of Ancestral Oceanic Society,* ed. M. Ross, A. Pawley, and M. Osmond. Vol. 1 of *Material Culture:* 67–114. Pacific Linguistics C-152. Canberra: Pacific Linguistics, Australian National University.

Parkinson, R.
1999 [1907] *Thirty Years in the South Seas.* Translated by J. Dennison and ed. J. P. White. Bathurst: Crawford House Publishing, in association with Oceania Publications, University of Sydney.

Pawley, A.
1967 The relationships of Polynesian Outliers languages. *Journal of the Polynesian Society* 76(3):259–296.

Pigram, C. J., and H. L. Davies
1987 Terranes and accretion history of the New Guinea orogen. *BMR Journal of Australian Geology and Geophysics* 10:193–211.

Rainbird, P.
2002 Pohnpei petroglyphs, communication and miscommunication. *Bulletin of the Indo-Pacific Prehistory Association* 22:141–146.
2004 *The Archaeology of Micronesia.* Cambridge, UK: Cambridge University Press.

Rainbird, P., and M. Wilson
2002 Crossing the line: The enveloped cross in Pohnpei, Federated States of Micronesia. *Antiquity* 76:635–636.

Ross, M. D.
1988 *Proto Oceanic and the Austronesian Languages of Western Melanesia.* Pacific Linguistics C-98. Canberra: Department of Linguistics, Australian National University.
1996a Pottery terms in Proto Oceanic, in *Oceanic Culture History: Essays in Honour of Roger Green:* 67–82, ed. J. Davidson, G. Irwin, B. F. Leach, A. Pawley, and D. Brown. Dunedin: New Zealand Journal of Archaeology.
1996b Is Yapese Oceanic? In *Reconstruction, Classification, Description: Festschrift in Honour of Isidore Dyen:* 121–166, ed. B. Nothofer. Hamburg: Abera.

Ross, M., A. Pawley, and M. Osmond
2003 *The Lexicon of Proto Oceanic: The Culture and Environment of Ancestral Oceanic Society.* Vol. 2 of *The Physical Environment.* Pacific Linguistics 545. Canberra: Department of Linguistics, Australian National University.

Rye, O. S.
1976 Keeping your temper under control: Materials and the manufacture of Papuan pottery. *Archaeology and Physical Anthropology in Oceania* 9(2):106–137.

Shutler, R., and J. C. Marck
1975 On the dispersal of the Austronesian horticulturalists. *Archaeology and Physical Anthropology in Oceania* 10(2):81–113.

Silver, E. A., L. D. Abbott, K. S. Kirchoff-Stein, D. L. Reed, and B. Bernstein-Taylor
1991 Collision propagation in Papua New Guinea and the Solomon Sea. *Tectonics* 10:863–874.

SPENNEMANN, D.H.R., AND W. R. AMBROSE
1997 Floating obsidian and its implications for the interpretation of Pacific prehistory. *Antiquity* 71:188–193.

SPRIGGS, M.
1997 *The Island Melanesians.* Oxford: Blackwell.

STUIVER, M., AND P. J. REIMER
1993 Extended 14C database and revised CALIB radiocarbon calibration program. *Radiocarbon* 35:215–230.

STUIVER, M., P. J. REIMER, E. BARD, J. W. BECK, G. S. BURR, K. A. HUGHEN, B. KROMER, F. G. MCCORMAC, J.V.D. PLICHT, AND M. SPURK
1998a INTCAL98 radiocarbon age calibration 24,000-0 cal. B.P. *Radiocarbon* 40:1041–1083.

STUIVER, M., P. J. REIMER, AND T. F. BRAZIUNAS
1998b High-precision radiocarbon age calibration for terrestrial and marine samples. *Radiocarbon* 40:1127–1154.

SUMMERHAYES, G.
2000 *Lapita Interaction.* Terra Australis 15. Canberra: Department of Archaeology and Natural History and Centre for Archaeological Research, Australian National University.

SWINDLER, D. R., AND M. I. WEISLER
2000 Dental size and morphology of precontact Marshall Islanders (Micronesia) compared with other Pacific Islanders. *Anthropological Science* 108:261–282.

TAKAYAMA, J.
1979 Archaeological investigations of PAAT-2 in the Palaus: An interim report, in *Report: Cultural Anthropological Research on the Folk Culture in the Western Caroline Islands of Micronesia in 1977:* 81–103, ed. H. Kusakabe. Tokyo: Committee for Micronesian Research, Tokyo University of Foreign Studies.

TAKAYAMA, J., M. INTOH, AND H. TAKASUGI
1980 *The Brief Archaeological Survey on Kayangel and Angaur in the Palaus.* Reports of the Pacific Archaeological Survey 7. Nara City: Tezukayama University.

TERRELL, J. E., AND R. L. WELSCH
1997 Lapita and the temporal geography of prehistory. *Antiquity* 71:548–572.

WATCHMAN, A.
1986 Brief petrological description of clay and pottery samples from the Siassi Islands and Huon Peninsula, Papua New Guinea. Appendix 2 in Lilley 1986:512–532.

WEISLER, M.
2000 Burial artifacts from the Marshall Islands: Descriptions, dating and evidence for extra-archipelago contacts. *Micronesica* 33(1/2):111–136.

WEISLER, M., AND D. SWINDLER
2002 Rocker jaws from the Marshall Islands: Evidence for interaction between eastern Micronesia and West Polynesia. *People and Culture in Oceania* 18:23–33.

WELSCH, R. L., AND J. E. TERRELL
1998 Material culture, social fields, and social boundaries on the Sepik coast of New Guinea, in *The Archaeology of Social Boundaries:* 50–77, ed. M. T. Stark. Washington, DC: Smithsonian Institution Press.

WICKLER, S.
2004 Modelling colonisation and migration in Micronesia from a zooarchaeological perspective, in *Colonisation, Migration, and Marginal Areas: A Zooarchaeological Approach:* 28–40, ed. M. Mondini, S. Muñoz, and S. Wickler. Oxford: Oxbow Books.

WILSON, M.
2002 Picturing Pacific Prehistory: The Rock-Art of Vanuatu in a Western Pacific Context. Unpubl. Ph.D. diss. Australian National University, Canberra.

WURM, S. A., AND S. HATTORI, EDS.
1981 *Language Atlas of the Pacific Area.* Canberra: Australian Academy of the Humanities, in collaboration with Japan Academy.

ABSTRACT

Type X is one of four Post-Lapita pottery styles reported from Huon Peninsula and the Siassi Islands of Papua New Guinea. Previous petrographic work was inconclusive about its likely area of origin but indicated a possible Huon Peninsula source. Renewed analysis of a larger sample supports this conclusion and confirms the use of grog temper. This kind of temper is otherwise not recorded in the New Guinea region, and its use in the production of Type X was probably culturally driven. Comparisons between Type X and grog-tempered pottery from Palau, Yap, and Pohnpei in Micronesia lead to the suggestion that Type X probably derived from an otherwise unrecorded contact between Huon Peninsula and Palau about 1000 years ago. The article reviews other evidence for interaction between the New Guinea–Bismarck Archipelago region and various parts of Micronesia and concludes that the proposed Type X connection with Palau is but one of several prehistoric contacts between different parts of the regions. Recognition of such contacts, which could have been unintentional and on a small scale, may contribute to explaining the complex ethnolinguistic situation of Huon Peninsula.